

# SOUTHWEST FISHERIES CENTER

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HONOLULU LABORATORY

NATIONAL MARINE FISHERIES SERVICE

April 1989

## ANNUAL REPORT OF THE 1988 WESTERN PACIFIC LOBSTER FISHERY

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with contributions from

Pacific Area Office  
Southwest Region

National Marine Fisheries Service, NOAA  
Honolulu, Hawaii 96822-2396

and

Southwest Enforcement  
National Marine Fisheries Service, NOAA  
Honolulu, Hawaii 96850

for the

Western Pacific Regional Fishery Management Council  
1164 Bishop Street, Suite 1405  
Honolulu, Hawaii 96813-2856

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## PREFACE

This is the sixth annual report on the western Pacific lobster fishery managed under the Crustacean Fishery Management Plan, which was prepared by the Western Pacific Regional Fishery Management Council and went into effect in March 1983. The western Pacific lobster fishery includes three management areas: permit area 1, the Northwestern Hawaiian Islands; permit area 2, the main Hawaiian Islands; and permit area 3, the islands of the territories of American Samoa and Guam. Permits are administered by the Pacific Area Office of the National Marine Fisheries Service and allow for lobster fishing operations in federally managed waters (3 to 200 nmi from shore).

In 1988, 22 permits were issued for area 1, 4 permits were issued for area 2, and none for area 3. Despite four permits being issued for the main Hawaiian Islands, no fishing activity was reported for the federally managed waters included in permit area 2. Therefore, all of the material presented in this report is for permit area 1, the Northwestern Hawaiian Islands.

This report provides the technical information stipulated in the Crustacean Fishery Management Plan of the western Pacific region. It also 1) presents fishery information provided by the Fishery Management Research Program of the Southwest Fisheries Center Honolulu Laboratory, National Marine Fisheries Service, NOAA; 2) summarizes biological research information provided by the Insular Resources Investigation of the Honolulu Laboratory; and 3) reports on other pertinent research related to the western Pacific lobster fishery. Separate sections on administrative activities and enforcement action were prepared by Peter A. Milone of the Pacific Area Office and Victor A. Honda of Southwest Enforcement, Honolulu.





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## INTRODUCTION

The Northwestern Hawaiian Islands (NWHI) are an uninhabited group of islands, islets, banks, and reefs that extend 1,200 nmi northwest, from Niihau Island to the vicinity of Kure Atoll. For over 10 years, these banks and islands have supported a commercial lobster trap fishery. The lobster fishery employs over 100 people, and ranks third in the State of Hawaii in terms of ex-vessel revenue (Hamm and Quach 1989).

The NWHI lobster fishery predominately targets two species: the spiny lobster, Panulirus marginatus, and the common slipper lobster, Scyllarides squammosus. In 1987, the ridgeback slipper lobster, S. haanii, also became a target of commercial exploitation. In addition, two other species, the green spiny lobster, P. penicillatus, and the Chinese slipper lobster, Parribacus antarcticus, continued to be caught incidentally, but their quantities were very small.

This report provides details on the commercial lobster fishing activities in the exclusive economic zone (EEZ) of Hawaii, concentrating specifically on the NWHI. Current catch, fishing effort, and revenue statistics are provided and compared with recent trends. The report also provides information on the biological and economic condition of the NWHI lobster fishery, concluding with separate sections on administration and enforcement activities in the fishery.

## DATA SOURCES

The majority of the data presented here are derived from logbook information, which is required by the Crustacean Fishery Management Plan (FMP) and provided by active lobster fishermen. This information includes a daily record of the statistical area fished, the number of traps set and hauled, and the number of spiny lobster and common slipper lobster caught. Fishermen have also been requested by the National Marine Fisheries Service (NMFS) to voluntarily report the number of ridgeback slipper lobster caught.

In addition to the fishing logbooks, the vessel operator or owner is required at the end of each fishing trip to submit to the NMFS a revenue report detailing the sales revenue, type, and weight of spiny and slipper lobster products landed as well as the weight and revenue received from octopus sales.

At the time of vessel arrival or off-loading, captains are contacted by NMFS personnel and interviewed for additional information. This information normally includes fishing success, vessel operations, and their overall impressions as to the state of the fishery, prices, and amount of gear lost. Summaries of this information are presented within the text.

## LANDINGS AND REVENUE

Summaries of the NWHI lobster products landed in 1977-88 are presented in Tables 1 and 2. Landing weight statistics (Table 1) are presented by year, wet weight calculated on a whole animal basis, and total ex-vessel revenue estimated for spiny and slipper lobsters. Table 2 presents a breakdown of revenue by product type (live, frozen whole, or frozen tails) and actual product weight landed. These tables contain minor revisions of previous years' data, which appeared in earlier annual reports.

In 1988, 553 metric tons (t) (wet weight) of spiny lobster and 85 t of common slipper lobster (henceforth referred to as slipper lobster) were landed from the NWHI lobster fishery. Compared with 1987 landings, estimated wet weight increased 129% for spiny lobster but declined 58% for slipper lobster. The combined wet weight of spiny and slipper lobster landings (638 t) represents a 45% increase in production over 1987. Landings of spiny lobster in 1988 were the second highest on record, whereas slipper lobster landings were the second lowest since 1983, the first year accurate records were kept on this species (Fig. 1).

Total gross ex-vessel revenue for the NWHI lobster fishery was \$5.0 million in 1988. This figure represents a 25% increase in total ex-vessel revenue from the revised 1987 figure of \$4.0 million.

Table 1.--Estimated annual sales of spiny and slipper lobsters from the Northwestern Hawaiian Islands, 1977-88. Ex-vessel price is in U.S. dollars per pound, and ex-vessel revenue is in U.S. dollars. Weight is in terms of whole animals, as is ex-vessel price. See text for source of data.

| Year              | Spiny lobster       |                |                  |           | Slipper lobster     |                |                  |           | Vessels<br>(No.) | Trips<br>(No.) |
|-------------------|---------------------|----------------|------------------|-----------|---------------------|----------------|------------------|-----------|------------------|----------------|
|                   | Pounds <sup>a</sup> | Metric<br>tons | Average<br>price | Revenue   | Pounds <sup>b</sup> | Metric<br>tons | Average<br>Price | Revenue   |                  |                |
| 1977              | 72,000              | 30             | 2.90             | 209,000   | --                  | --             | --               | --        | 5                | 14             |
| 1978              | 45,000              | 20             | 3.00             | 135,000   | --                  | --             | --               | --        | 2                | 12             |
| 1979              | 100,000             | 50             | 3.20             | 320,000   | --                  | --             | --               | --        | 2                | 6              |
| 1980              | 328,000             | 150            | 3.40             | 1,115,000 | --                  | --             | --               | --        | 3                | 12             |
| 1981              | 780,000             | 350            | 3.50             | 2,730,000 | --                  | --             | --               | --        | 10               | 25             |
| 1982              | 187,000             | 80             | 3.60             | 673,000   | --                  | --             | --               | --        | 7                | 19             |
| 1983              | 203,000             | 90             | 2.91             | 591,000   | --                  | --             | --               | --        | 4                | 19             |
| 1984              | 935,000             | 425            | 2.66             | 2,490,000 | 82,000              | 37             | 1.63             | 134,000   | 11               | 38             |
| 1985              | 1,438,000           | 654            | 2.94             | 4,227,000 | 930,000             | 423            | 1.78             | 1,660,000 | 16               | 62             |
| 1986              | 1,149,000           | 521            | 3.23             | 3,710,000 | 1,053,000           | 479            | 2.16             | 2,272,000 | 16               | 60             |
| 1987              | 530,000             | 241            | 4.67             | 2,479,000 | 439,000             | 200            | 3.44             | 1,509,000 | 11               | 38             |
| 1988 <sup>c</sup> | 1,217,000           | 553            | 3.65             | 4,436,000 | 187,000             | 85             | 3.12             | 583,000   | 9                | 28             |

<sup>a</sup>Includes frozen tail weight expanded to represent whole weight (tail weight = 35.6% of whole weight).

<sup>b</sup>Includes frozen tail weight expanded to represent whole weight (tail weight = 33.3% of whole weight).

<sup>c</sup>Preliminary estimate.



Table 2.--Estimated annual sales of spiny and slipper lobsters, by product type, from the Northwestern Hawaiian Islands, 1977-88. Ex-vessel price is in U.S. dollars per pound; ex-vessel revenue is in U.S. dollars.

| Year              | Product type  | Spiny lobster |                 |       |           | Slipper lobster |                 |       |           | Vessels<br>(No.) | Trips<br>(No.) |
|-------------------|---------------|---------------|-----------------|-------|-----------|-----------------|-----------------|-------|-----------|------------------|----------------|
|                   |               | Pounds        | Metric<br>tons  | Price | Revenue   | Pounds          | Metric<br>tons  | Price | Revenue   |                  |                |
| 1977              | Live          | 72,000        | 33              | 2.90  | 208,800   | --              | --              | --    | --        | 5                | 14             |
| 1978              | Live          | 45,000        | 20              | 3.00  | 135,000   | --              | --              | --    | --        | 2                | 12             |
| 1979              | Live          | 100,000       | 45              | 3.20  | 320,000   | --              | --              | --    | --        | 2                | 6              |
| 1980              | Not available |               |                 |       |           |                 |                 |       |           |                  |                |
| 1981              | Not available |               |                 |       |           |                 |                 |       |           |                  |                |
| 1982              | Not available |               |                 |       |           |                 |                 |       |           |                  |                |
| 1983 <sup>a</sup> | Live          | 25,000        | 11              | 4.46  | 111,600   | --              | --              | --    | --        | 4                | 12             |
|                   | Frozen whole  | 15            | 0               | 4.00  | 60        | --              | --              | --    | --        | 1                | 1              |
|                   | Frozen tails  | 51,400        | 23              | 7.41  | 380,800   | --              | --              | --    | --        | 2                | 7              |
| 1984              | Live          | 36,500        | 17              | 4.70  | 171,700   | --              | --              | --    | --        | 7                | 9              |
|                   | Frozen whole  | 3,500         | 2               | 3.98  | 13,800    | 100             | -- <sup>b</sup> | 3.00  | 400       | 3                | 6              |
|                   | Frozen tails  | 318,600       | 145             | 7.23  | 2,304,500 | 27,300          | 12              | 4.92  | 134,000   | 10               | 31             |
| 1985              | Live          | 35,200        | 16              | 4.71  | 165,800   | 30              | -- <sup>b</sup> | 3.90  | 100       | 7                | 21             |
|                   | Frozen whole  | 2,800         | 1               | 4.08  | 12,800    | 600             | -- <sup>b</sup> | 2.73  | 1,600     | 3                | 8              |
|                   | Frozen tails  | 498,000       | 226             | 8.13  | 4,050,000 | 310,000         | 141             | 5.35  | 1,660,000 | 15               | 56             |
| 1986              | Live          | 18,200        | 8               | 5.10  | 92,880    | 100             | -- <sup>b</sup> | 5.25  | 600       | 6                | 16             |
|                   | Frozen whole  | 15,500        | 7               | 3.84  | 59,500    | 3,600           | 2               | 2.45  | 8,700     | 6                | 9              |
|                   | Frozen tails  | 397,000       | 180             | 8.96  | 3,558,000 | 350,000         | 159             | 6.47  | 2,263,000 | 16               | 56             |
| 1987 <sup>c</sup> | Live          | 12,400        | 6               | 6.50  | 80,900    | 5,500           | 3               | 7.29  | 40,400    | 3                | 9              |
|                   | Frozen whole  | 800           | -- <sup>b</sup> | 5.78  | 4,600     | 1,800           | 1               | 3.96  | 7,100     | 3                | 3              |
|                   | Frozen tails  | 183,200       | 83              | 13.00 | 2,383,000 | 143,000         | 65              | 10.16 | 1,452,000 | 10               | 37             |
| 1988 <sup>d</sup> | Live          | 6,000         | 3               | 7.51  | 44,900    | 4,400           | 2               | 7.64  | 34,100    | 4                | 8              |
|                   | Frozen whole  | 1,400         | 1               | 4.00  | 5,500     | --              | --              | --    | --        | 3                | 3              |
|                   | Frozen tails  | 430,000       | 196             | 10.19 | 4,385,100 | 60,800          | 28              | 9.03  | 549,000   | 9                | 28             |

<sup>a</sup>April through December 1983.

<sup>b</sup>Less than 1 t landed.

<sup>c</sup>Revised from 1987 annual report.

<sup>d</sup>Preliminary figures.



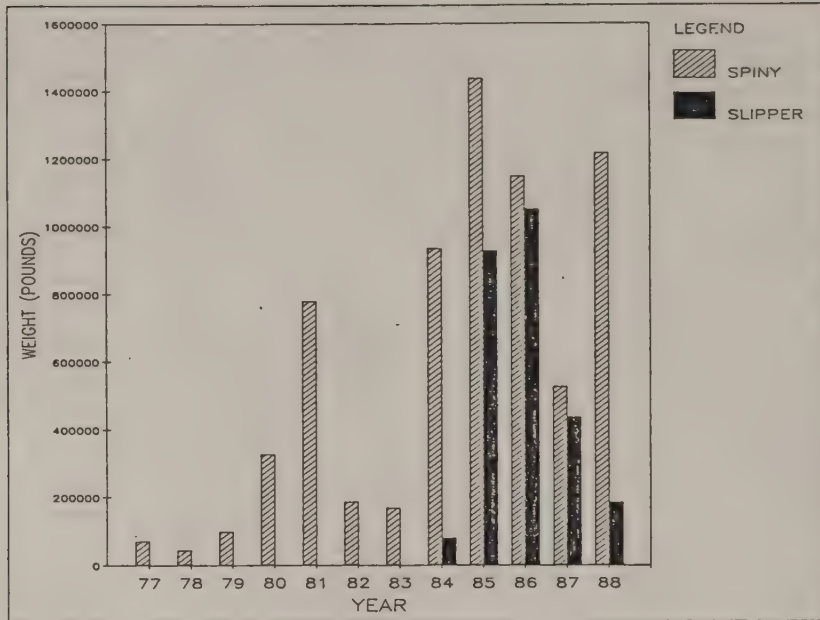


Figure 1.--Estimated annual landings (wet weight) of spiny and slipper lobsters for the lobster fishery in the Northwestern Hawaiian Islands, 1977-88.

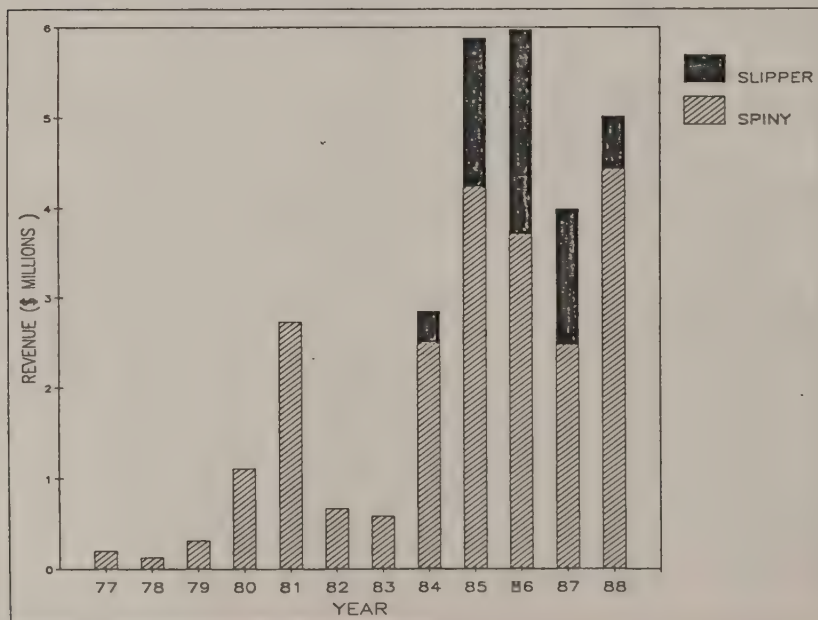


Figure 2.--Revenue for spiny and slipper lobsters for the lobster fishery in the Northwestern Hawaiian Islands, 1977-88.

Spiny lobster ex-vessel revenue was \$4.4 million in 1988, up 80% from the revised 1987 revenue of \$2.5 million (Fig. 2). The revenue generated by spiny lobster was the highest on record. Slipper lobster revenue for 1988 was \$0.6 million, down 61% from the revised 1987 figure of \$1.5 million. The 1988 slipper lobster figure is the second lowest in the history of the fishery, behind only 1983, the first year of differentiation between spiny and slipper lobster revenue.

### Production by Product Type

As in the last 6 years, frozen lobster tails were the predominate product type of the NWHI lobster fishery in 1988 (Table 2). The sale of frozen tails accounted for 98.9% of the total estimated revenue generated from spiny lobster products, with live and frozen whole lobster accounting for the rest. Frozen tails accounted for 94.1% of the revenue generated from slipper lobster products, and live lobster for the remainder.

Frozen spiny lobster tails provided the largest source of income (\$4.4 million) in the NWHI lobster fishery in 1988. Frozen slipper lobster tails continued to be the second largest generator of revenue in the NWHI lobster fishery at \$0.5 million. Sales reports indicate that only 872 lb (0.4 t) of octopus were sold for a total value of \$872. No sales were reported in the "other" category.

### Price

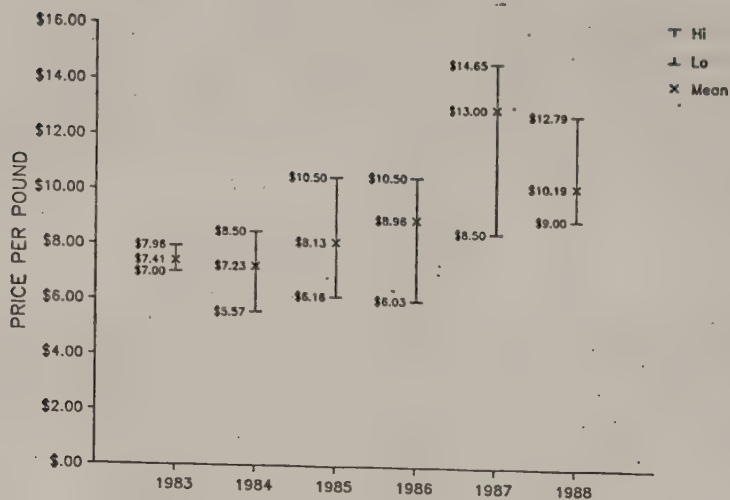
In 1988, the average wet weight prices per pound were \$3.65 for spiny lobster and \$3.12 for slipper lobster (Table 1). The ex-vessel prices for both frozen spiny and slipper lobster tails dropped significantly in 1988 while the price for live lobster rose. The average ex-vessel price of frozen spiny lobster tails slipped from \$13.00 in 1987 to \$10.19 in 1988 while slipper lobster price fared a little better dropping only from \$10.16 in 1987 to \$9.03 in 1988. The price differential between spiny and slipper lobsters has declined significantly in the last 2 years (Fig. 3). The ex-vessel price of live lobster rose from \$6.75 in 1987 to between \$7.50 and \$7.75 in 1988 (Table 2).

### CATCH AND EFFORT

#### Catch Composition

There were 889,005 legal, 278,802 sublegal, and 114,894 berried spiny lobster reported caught in the NWHI lobster fishery in 1988 (Table 3a). In addition, 278,780 total slipper lobster were reported caught, of which 168,607 were legal, 69,317 sublegal, and 40,856 berried. For the first time, slipper lobster were subject to the same reporting requirements as spiny lobster. Therefore, slipper lobster can now be broken down into respective legal, sublegal, and berried categories. Table 3b presents the

## SPINY LOBSTER



## SLIPPER LOBSTER

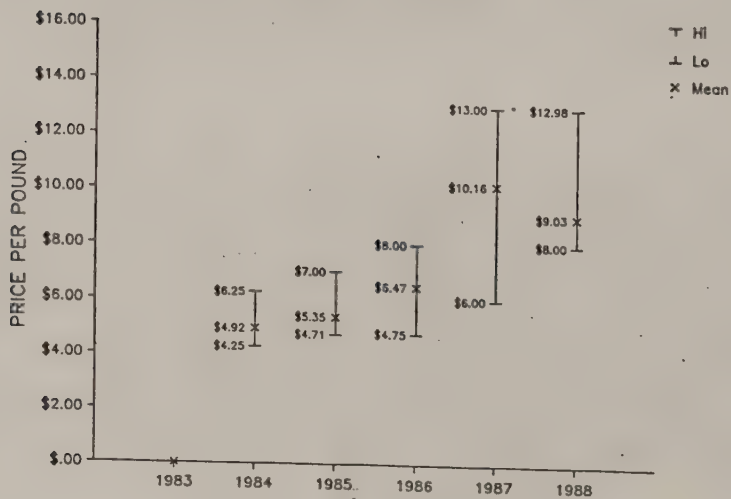


Figure 3.--Low, mean, and high ex-vessel prices of spiny lobster and slipper lobster frozen tails, in U.S. dollars, 1983-88.



Table 3a.--Annual catch of spiny and slipper lobsters, by area, in the Northwestern Hawaiian Islands, 1988.

| Area                  | Vessels<br>(No.) | Trips<br>(No.) | Catch (in numbers)        |                              |                             |                           |                             |                                |                               |                             |
|-----------------------|------------------|----------------|---------------------------|------------------------------|-----------------------------|---------------------------|-----------------------------|--------------------------------|-------------------------------|-----------------------------|
|                       |                  |                | Legal<br>spiny<br>lobster | Sublegal<br>spiny<br>lobster | Berried<br>spiny<br>lobster | Total<br>spiny<br>lobster | Legal<br>slipper<br>lobster | Sublegal<br>slipper<br>lobster | Berried<br>slipper<br>lobster | Total<br>slipper<br>lobster |
| Necker Island         | 4                | 8              | 140,158                   | 56,573                       | 15,723                      | 212,454                   | 29,490                      | 2,410                          | 920                           | 32,820                      |
| French Frigate Shoals | 3                | 3              | 20,303                    | 10,539                       | 2,386                       | 33,228                    | 3,055                       | 1,214                          | 263                           | 4,532                       |
| St. Rogatien Bank     | 4                | 5              | 114,413                   | 11,597                       | 4,524                       | 130,534                   | 13,493                      | 1,235                          | 228                           | 14,956                      |
| Gardner Pinnacles     | 6                | 9              | 154,080                   | 24,788                       | 8,904                       | 187,772                   | 17,203                      | 9,113                          | 636                           | 26,952                      |
| Maro Reef             | 7                | 13             | 452,523                   | 170,545                      | 78,944                      | 702,012                   | 79,268                      | 43,924                         | 32,575                        | 155,767                     |
| Other <sup>a</sup>    | 7                | 7              | 7,528                     | 4,760                        | 4,413                       | 16,701                    | 26,098                      | 11,421                         | 6,234                         | 43,753                      |
| Total                 | 9                | 28             | 889,005                   | 278,802                      | 114,894                     | 1,282,701                 | 168,607                     | 69,317                         | 40,856                        | 278,780                     |

<sup>a</sup>Includes Nihoa, Brooks Banks, Raita Bank, Northampton Seamounts, Lisianski Island, Pioneer Bank, Pearl and Hermes Reef, and Kure Atoll.

Table 3b.--Average annual catch of spiny and slipper lobsters, by area, in the Northwestern Hawaiian Islands, 1985-87.

| Area                        | Catch (in numbers)     |                              |                             |                        |                          |
|-----------------------------|------------------------|------------------------------|-----------------------------|------------------------|--------------------------|
|                             | Legal spiny<br>lobster | Sublegal<br>spiny<br>lobster | Berried<br>spiny<br>lobster | Total spiny<br>lobster | Total slipper<br>lobster |
| Nihoa                       | 5,680                  | 279                          | 2,018                       | 7,977                  | 14,199                   |
| Necker Island               | 152,985                | 141,084                      | 32,820                      | 326,889                | 108,039                  |
| French Frigate Shoals       | 30,461                 | 19,326                       | 8,598                       | 58,386                 | 15,099                   |
| Brooks Banks                | 18,010                 | 4,229                        | 2,859                       | 25,098                 | 58,191                   |
| St. Rogatien Bank           | 113,826                | 23,626                       | 15,670                      | 153,122                | 88,914                   |
| Gardner Pinnacles           | 72,576                 | 16,450                       | 11,588                      | 100,601                | 121,144                  |
| Raita Bank                  | 22,522                 | 2,560                        | 2,184                       | 27,265                 | 32,723                   |
| Maro Reef                   | 297,866                | 82,192                       | 50,568                      | 430,626                | 397,838                  |
| Northampton Seamounts       | 452                    | 92                           | 68                          | 613                    | 14,894                   |
| Lisianski Island            | 844                    | 72                           | 75                          | 990                    | 9,936                    |
| Pearl and Hermes Reef       | 25,033                 | 3,725                        | 884                         | 29,641                 | 36,671                   |
| Areas combined <sup>a</sup> | 740,256                | 293,635                      | 127,331                     | 1,161,208              | 897,649                  |
| All areas <sup>b</sup>      | 749,002                | 295,549                      | 128,842                     | 1,173,379              | 967,979                  |

<sup>a</sup>Only areas fished in all 3 years.

<sup>b</sup>Includes all areas fished between 1985 and 1987.

3-year averages of catches at the different banks. Reported catches of octopus equaled 647 in 1988.

Maro Reef, Gardner Pinnacles, and Necker Island (in descending order) produced the greatest number of legal spiny lobster in 1988. These three banks produced 84% of the legal and 86% of the total spiny lobster reported caught in the NWHI lobster fishery. St. Rogatien Bank, which was a major producer of both spiny and slipper lobsters in 1985-86 but had declined in 1987, rebounded in 1988 and produced 114,413 legal spiny lobster, placing it fourth in spiny lobster production.

In 1988, as in 1987, the majority of the slipper lobster were caught at Maro Reef. Maro Reef produced a greater proportion of the NWHI total slipper lobster catch in 1988 (57%) than in 1987 (37%). Necker Island produced the second greatest number of total slipper lobster (12%). The eight "other" banks together produced the third greatest number of slipper lobster.

Maro Reef produced 55% of the reported combined total catch of spiny and slipper lobsters in the NWHI lobster fishery, followed by Necker Island (16%) and Gardner Pinnacles (14%). Absolute and relative contributions to the fishery continued to increase at Maro Reef and decline at Necker Island. Production at Gardner Pinnacles increased significantly from 1987 levels.

The contributions of the various catch categories (legal, sublegal, and berried spiny and slipper lobsters) are presented in Figure 4. This is the first year slipper lobster are presented in terms of legal, sublegal, and berried lobster; therefore, comparisons with previous years are available for only the total slipper lobster catch. In 1988, legal spiny lobster represented 57% of the total NWHI lobster catch, followed by spiny lobster (18%), total slipper lobster (18%), and finally berried spiny lobster (7%). The relative contribution of legal spiny lobster in 1988 was the highest since 1984, while the contribution of total slipper lobster dropped below the 1984 level (of approximately 22%). The relative contribution of sublegal spiny lobster was about equal to that reported in 1987. The total slipper lobster contribution of 17.9% of the total NWHI lobster catch in 1988 can be broken down into legal (10.8%), sublegal (4.4%), and berried lobster (2.6%) categories.

#### Fishing Effort

In 1988, fishing effort, in terms of number of trips taken and reported fishing days, was down from 1987; however, the number of trap-hauls increased slightly. In 1987, 38 trips were recorded for the NWHI lobster fishery, but in 1988, only 28 trips were reported. Trip effort in terms of area fished in 1988 was similar to last year and had the same general pattern as in the last 3 years (Table 3a). Trip effort was concentrated around the mainstay banks of Maro Reef, Necker Island, and Gardner Pinnacles, which were fished by lobster vessels on 13, 8, and 9 trips, respectively (Table 3a).

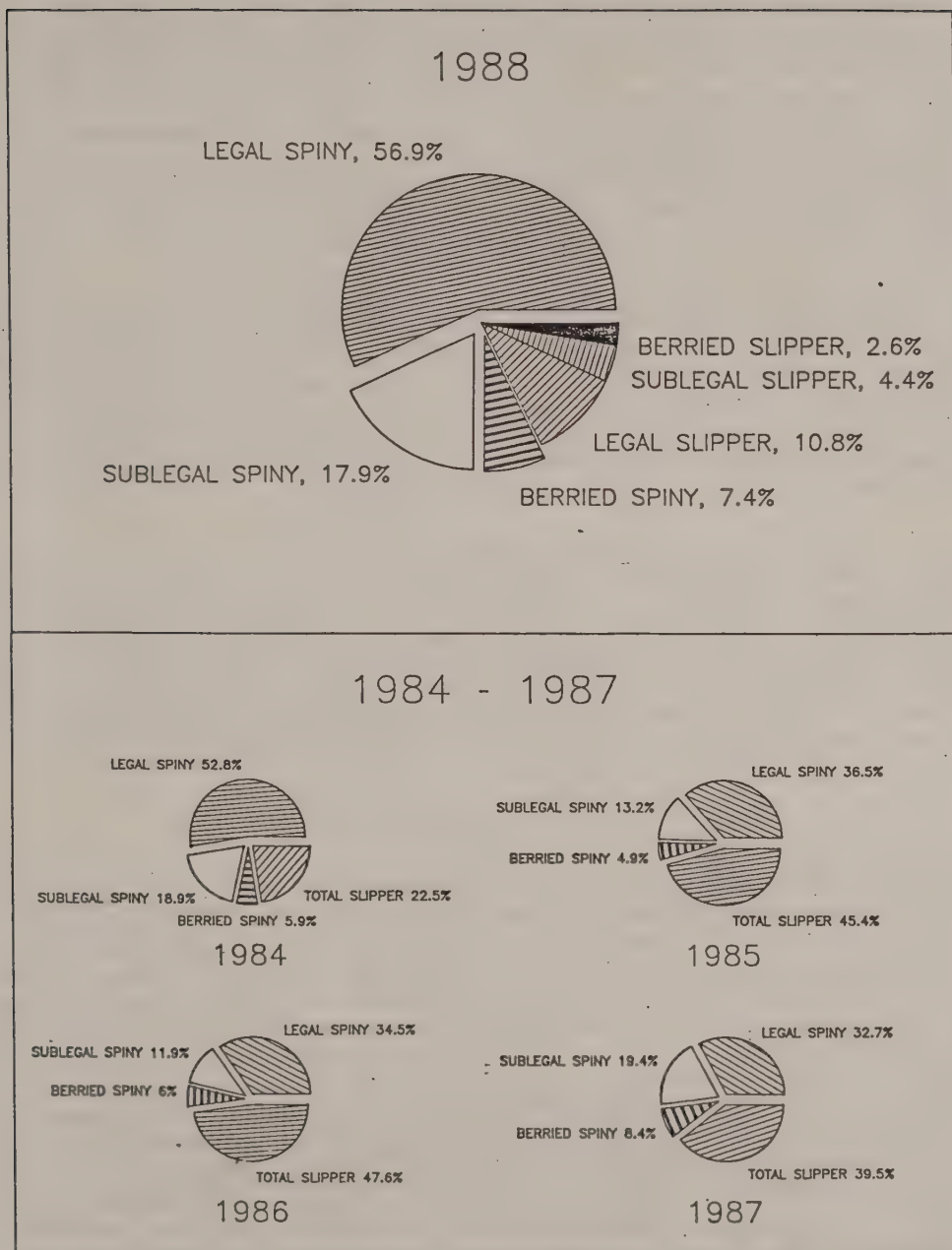


Figure 4.--Composition of the lobster catch from the Northwestern Hawaiian Islands, 1983-88.



In 1988, 845,182 trap-hauls were recorded by the NWHI lobster fishermen, an increase of 5% from 1987 (Table 4a). Trap-hauls in 1988 were substantially less than the 3-year (1985-87) average of 1.0 million trap-hauls (Table 4b). In 1988, 45% of the total trap-hauls in the NWHI were recorded at Maro Reef, continuing a 3-year trend in which Maro Reef accounted for the largest portion of trap-hauls in the NWHI lobster fishery. Next was Necker Island, with 18.6% of the total trap-hauls, followed closely by Gardner Pinnacles (17.3%) and then St. Rogatien Bank (10.2%). Maro Reef continued to be the center of effort in the NWHI lobster fishery; Necker Island continued a 3-year trend in declining effort.

In 1988, the total number of reported fishing days dropped by 5% for the entire fleet from the 1987 total of 1,217 (Table 4a). However, Maro Reef experienced a substantial increase in reported fishing days, jumping from 348 in 1987 to 535 in 1988. The average number of trap-hauls per reported day of fishing rose from 661 in 1987 to 732 in 1988. This increase of 71 additional trap-hauls per fishing day may represent the fleet's reconfiguration in 1988 with a relatively larger component of Class II vessels (mid-sized vessels; see Clarke and Pooley (1988)).

Fishing days (i.e., days in which a vessel hauled gear from a bank) were greatest at Maro Reef, Necker Island, Gardner Pinnacles, and St. Rogatien Bank (Table 4a). The trap-hauls per reported day of fishing were greatest for St. Rogatien Bank (849), Gardner Pinnacles (806), French Frigate Shoals (804), Maro Reef (715), and Necker Island (670). In 1988, if one were to spread the total number of trap-hauls at a particular bank over the entire year (365 days), Maro Reef and Necker Island would average 1,052 and 432 trap-hauls daily. These levels approximate the 3-year average.

#### Catch Per Unit Effort

Total spiny lobster catch per unit effort (CPUE) (catch per trap-haul) was 1.52, and total slipper lobster CPUE was 0.33 in 1988 (Table 4a). Total spiny lobster CPUE in 1988 was well above the 3-year average while total slipper lobster CPUE was well below. The CPUE information by area is presented in Table 4a, and the 3-year averages for banks fished in 1985-87 are presented in Table 4b. St. Rogatien Bank had the highest legal spiny lobster CPUE in 1988, with Maro Reef second, while the combined banks in the "other" category had the lowest CPUE (Fig. 5). Total slipper lobster CPUE's were highest for the "other" category, followed by Maro Reef. Combining the legal spiny lobster CPUE with the total slipper lobster CPUE, Maro Reef ranked first at 1.59 lobster per trap-haul, St. Rogatien Bank ranked second (1.48), and Gardner Pinnacles third (1.23). The lowest combined lobster CPUE's were recorded at French Frigate Shoals (1.03) and the "other" category (1.08).

The combined CPUE (legal spiny lobster and total slipper lobster) increased 28% in 1988 from 1987 levels. Legal spiny lobster CPUE jumped significantly while total slipper lobster CPUE declined. Therefore, the increase in CPUE can be predominately attributed to spiny lobster.

Table 4a.--Annual fishing effort (in trap-hauls) and mean catch per trap-haul for spiny and slipper lobsters in the Northwestern Hawaiian Islands, 1988. Data are from the Daily Lobster Catch Report per Statistical Area as required by the Crustacean Fishery Management Plan.

| Area                     | Catch (in numbers) per trap-haul |                         |                           |                              |                             |                           |                             |                                |                               |                             |
|--------------------------|----------------------------------|-------------------------|---------------------------|------------------------------|-----------------------------|---------------------------|-----------------------------|--------------------------------|-------------------------------|-----------------------------|
|                          | Days<br>fished<br>(No.)          | Trap-<br>hauls<br>(No.) | Legal<br>spiny<br>lobster | Sublegal<br>spiny<br>lobster | Berried<br>spiny<br>lobster | Total<br>spiny<br>lobster | Legal<br>slipper<br>lobster | Sublegal<br>slipper<br>lobster | Berried<br>slipper<br>lobster | Total<br>slipper<br>lobster |
| Necker                   | 235                              | 157,540                 | 0.89                      | 0.36                         | 0.10                        | 1.35                      | 0.19                        | 0.02                           | 0.01                          | 0.21                        |
| French Frigate<br>Shoals | 30                               | 24,130                  | 0.84                      | 0.44                         | 0.10                        | 1.38                      | 0.13                        | 0.05                           | 0.01                          | 0.19                        |
| St. Rogatien Bank        | 103                              | 87,421                  | 1.31                      | 0.13                         | 0.05                        | 1.49                      | 0.15                        | 0.01                           | 0.00                          | 0.17                        |
| Gardner Pinnacles        | 181                              | 146,057                 | 1.05                      | 0.17                         | 0.06                        | 1.29                      | 0.12                        | 0.06                           | 0.00                          | 0.18                        |
| Maro Reef                | 535                              | 382,771                 | 1.18                      | 0.45                         | 0.21                        | 1.83                      | 0.21                        | 0.11                           | 0.09                          | 0.41                        |
| Other*                   | 70                               | 47,263                  | 0.16                      | 0.10                         | 0.09                        | 0.35                      | 0.55                        | 0.24                           | 0.13                          | 0.92                        |
| Totals                   | 1,154                            | 845,182                 | 1.05                      | 0.33                         | 0.14                        | 1.52                      | 0.20                        | 0.08                           | 0.05                          | 0.33                        |

\*Includes Nihoa, Brooks Banks, Raita Bank, Northampton Seamounts, Lisianski Island, Pioneer Bank, Pearl and Hermes Reef, and Kure Atoll.

Table 4b.--Average annual fishing effort (in trap-hauls) and mean catch per trap-haul for spiny and slipper lobsters in the Northwestern Hawaiian Islands lobster fishery, 1985-87. Data are from the Daily Lobster Catch Report per Statistical Area as required by the Crustacean Fishery Management Plan.

| Area                  | Catch (in numbers) per trap-haul |                         |                           |                              |                             |                           |                             |
|-----------------------|----------------------------------|-------------------------|---------------------------|------------------------------|-----------------------------|---------------------------|-----------------------------|
|                       | Days<br>fished<br>(No.)          | Trap-<br>hauls<br>(No.) | Legal<br>spiny<br>lobster | Sublegal<br>spiny<br>lobster | Berried<br>spiny<br>lobster | Total<br>spiny<br>lobster | Total<br>slipper<br>lobster |
| Nihoa                 | 49                               | 21,114                  | 0.34                      | 0.02                         | 0.09                        | 0.44                      | 0.63                        |
| Necker Island         | 386                              | 194,924                 | 0.78                      | 0.73                         | 0.17                        | 1.68                      | 0.56                        |
| French Frigate Shoals | 63                               | 38,833                  | 0.73                      | 0.43                         | 0.19                        | 1.35                      | 0.40                        |
| Brooks Banks          | 65                               | 39,713                  | 0.48                      | 0.14                         | 0.11                        | 0.73                      | 1.26                        |
| St. Rogatien Bank     | 170                              | 126,721                 | 0.78                      | 0.17                         | 0.10                        | 1.06                      | 0.60                        |
| Gardner Pinnacles     | 211                              | 139,752                 | 0.50                      | 0.13                         | 0.08                        | 0.71                      | 0.85                        |
| Raita Bank            | 100                              | 49,555                  | 0.53                      | 0.05                         | 0.03                        | 0.61                      | 0.57                        |
| Maro Reef             | 495                              | 347,179                 | 0.86                      | 0.25                         | 0.15                        | 1.25                      | 1.13                        |
| Northampton Seamounts | 14                               | 9,978                   | 0.08                      | 0.01                         | 0.01                        | 0.10                      | 1.65                        |
| Lisianski Island      | 11                               | 7,070                   | 0.09                      | 0.01                         | 0.01                        | 0.12                      | 0.99                        |
| Pearl and Hermes Reef | 53                               | 33,605                  | 0.66                      | 0.08                         | 0.02                        | 0.76                      | 1.25                        |
| Areas combined*       | 1,617                            | 1,008,444               | 0.73                      | 0.30                         | 0.13                        | 1.15                      | 0.87                        |

\*Only areas fished in all 3 years.

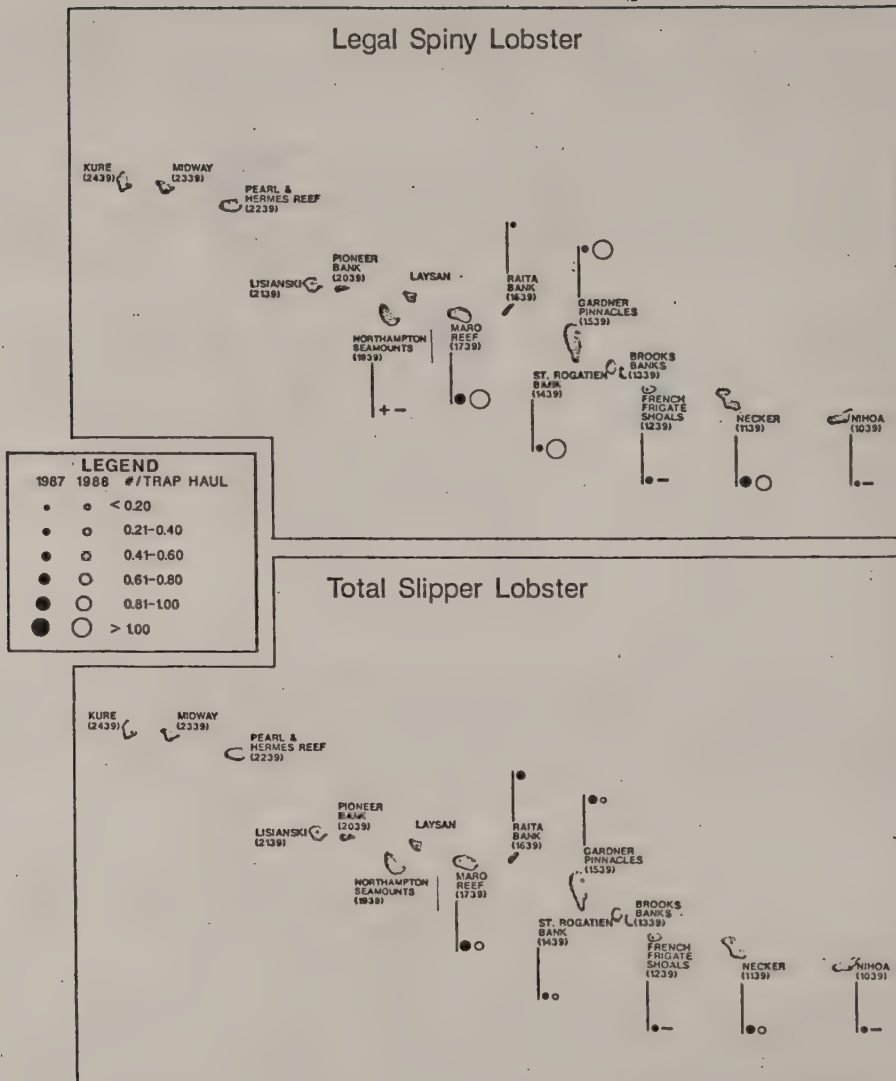


Figure 5.--Catch per trap-haul of legal spiny lobster and total slipper lobster, by bank, in the Northwestern Hawaiian Islands, 1987-88. Numbers in parentheses are area statistical reporting codes.



The decline in slipper lobster CPUE appears to mainly be the result of targeting practices of fishermen. Fishermen reported that both wind and sea conditions allowed fishing on top of the banks throughout most of the year. Spiny lobster predominate in this upper bank area, whereas slipper lobster tend to be found in deeper waters or around the deeper edges of the banks. With most of the fishing activity on top of the banks, catches of slipper lobster were incidental to spiny lobster as was the case in 1977-83. Several other factors may have led to this unexpectedly high spiny lobster CPUE (cf. Polovina and Moffitt 1989).

Monthly CPUE figures for spiny and slipper lobsters, calculated by using date of haul, are presented in Table 5a for 1988. All CPUE numbers presented in Table 5 are by date of haul, that is, the date when the gear was hauled, not the date of arrival in Honolulu (date of arrival is used in Tables 3-4). In 1988, there were several months in which fewer than three vessels fished; therefore, no data for these months appear in the table. In 1988, legal spiny lobster CPUE peaked in July and October. Legal slipper lobster CPUE peaked in February, and the reported catch of total slipper lobster peaked in May.

Average monthly CPUE for 1985-87 is summarized in Table 5b. During the last 3 years, August proved to be the best month for legal spiny lobster fishing, whereas total slipper lobster CPUE peaked in April when legal spiny lobster CPUE was at its lowest. Also, effort was concentrated in May through November as evidenced by reported trap-hauls per month.

#### VESSEL OPERATIONAL PERFORMANCE

The number of sea days of the NWHI lobster fleet is reported in adjusted and unadjusted modes for 1988 (Table 6). Adjusted data delete incomplete or experimental trips and annualize the vessel activity. The adjusted fleet class configuration shows one Class I vessel, four Class II, and three Class III vessels active in 1988. One Class I vessel was eliminated from the analysis because it took only one trip in 1988. For a complete description of vessel classes and sea day analysis, see Clarke and Pooley (1988).

In 1988, the average NWHI lobster vessel took 3.8 trips, down from last year's average of 4.3 (Clarke et al. 1988) and significantly less than the 1985-86 average of 4.6 (Clarke and Pooley 1988). Average overall trip duration in 1988 was almost a week longer than in 1987 (52 day vs. 46 days). Total sea days for each vessel (fleet mean) equaled 195 days, with fishing days (152) accounting for 78% of trip duration. Running days (29) accounted for 14% of trip duration while traveling days (3) accounted for only 1%. Inclement weather days (4) comprised 2% of trip duration while missing days (2) or those not accounted for equaled 1%. The balance was spread between rest and deck work (4) and breakdown days (1).

Table 5a.--Monthly catch per trap-haul of spiny lobster and slipper lobster by date of haul for the lobster fleet in the Northwestern Hawaiian Islands, 1988. Data are from the Daily Catch Report per Statistical Area as required by the Crustacean Fishery Management Plan.

| Date<br>1988 | Areas           | Trap-<br>hauls<br>(No.) | Catch (in numbers) per trap-haul |                              |                             |                           |                             |                                |                               |                             |
|--------------|-----------------|-------------------------|----------------------------------|------------------------------|-----------------------------|---------------------------|-----------------------------|--------------------------------|-------------------------------|-----------------------------|
|              |                 |                         | Legal<br>spiny<br>lobster        | Sublegal<br>spiny<br>lobster | Berried<br>spiny<br>lobster | Total<br>spiny<br>lobster | Legal<br>slipper<br>lobster | Sublegal<br>slipper<br>lobster | Berried<br>slipper<br>lobster | Total<br>slipper<br>lobster |
| January      | 4               | 30,970                  | 0.56                             | 0.16                         | 0.05                        | 0.78                      | 0.16                        | 0.04                           | 0.00                          | 0.21                        |
| February     | 7               | 83,180                  | 0.66                             | 0.17                         | 0.05                        | 0.88                      | 0.38                        | 0.09                           | 0.03                          | 0.50                        |
| March        | 4               | 63,430                  | 0.66                             | 0.22                         | 0.04                        | 0.92                      | 0.19                        | 0.07                           | 0.05                          | 0.31                        |
| April        | -- <sup>a</sup> |                         |                                  |                              |                             |                           |                             |                                |                               |                             |
| May          | 3               | 30,480                  | 0.97                             | 0.32                         | 0.31                        | 1.61                      | 0.24                        | 0.14                           | 0.18                          | 0.56                        |
| June         | -- <sup>a</sup> |                         |                                  |                              |                             |                           |                             |                                |                               |                             |
| July         | 4               | 94,734                  | 1.40                             | 0.34                         | 0.26                        | 2.01                      | 0.19                        | 0.11                           | 0.08                          | 0.39                        |
| August       | 7               | 150,928                 | 1.13                             | 0.27                         | 0.15                        | 1.55                      | 0.15                        | 0.05                           | 0.02                          | 0.22                        |
| September    | 5               | 96,476                  | 1.12                             | 0.41                         | 0.11                        | 1.64                      | 0.11                        | 0.06                           | 0.01                          | 0.18                        |
| October      | -- <sup>a</sup> |                         |                                  |                              |                             |                           |                             |                                |                               |                             |
| November     | 4               | 63,714                  | 1.22                             | 0.85                         | 0.09                        | 2.15                      | 0.15                        | 0.06                           | 0.00                          | 0.21                        |
| December     | -- <sup>a</sup> |                         |                                  |                              |                             |                           |                             |                                |                               |                             |
| Cumulative   | 13              | 837,932 <sup>b</sup>    | 1.06                             | 0.33                         | 0.14                        | 1.53                      | 0.20                        | 0.08                           | 0.05                          | 0.33                        |

<sup>a</sup>Confidential data.

<sup>b</sup>Total different from Table 4 because date of haul was used.

Table 5b.--Average monthly catch per trap-haul of spiny lobster and slipper lobster by date of haul for the lobster fleet in the Northwestern Hawaiian Islands, 1985-87. Data are from the Daily Catch Report per Statistical Area as required by the Crustacean Fishery Management Plan.

| Date       | Areas | Trap-<br>hauls<br>(No.) | Catch (in numbers) per trap-haul |                              |                             |                           |                             |
|------------|-------|-------------------------|----------------------------------|------------------------------|-----------------------------|---------------------------|-----------------------------|
|            |       |                         | Legal<br>spiny<br>lobster        | Sublegal<br>spiny<br>lobster | Berried<br>spiny<br>lobster | Total<br>spiny<br>lobster | Total<br>slipper<br>lobster |
| January    | 7     | 47,874                  | 0.75                             | 0.40                         | 0.08                        | 1.22                      | 0.34                        |
| February   | 7     | 67,171                  | 0.71                             | 0.37                         | 0.07                        | 1.14                      | 1.05                        |
| March      | 8     | 61,865                  | 0.36                             | 0.20                         | 0.06                        | 0.63                      | 1.38                        |
| April      | 8     | 53,211                  | 0.23                             | 0.15                         | 0.06                        | 0.44                      | 1.51                        |
| May        | 8     | 101,994                 | 0.45                             | 0.22                         | 0.12                        | 0.80                      | 1.39                        |
| June       | 8     | 96,044                  | 0.67                             | 0.25                         | 0.14                        | 1.07                      | 1.10                        |
| July       | 7     | 113,077                 | 0.96                             | 0.27                         | 0.17                        | 1.40                      | 0.79                        |
| August     | 7     | 111,219                 | 1.03                             | 0.32                         | 0.21                        | 1.56                      | 0.52                        |
| September  | 7     | 104,614                 | 0.94                             | 0.30                         | 0.13                        | 1.38                      | 0.54                        |
| October    | 7     | 122,312                 | 0.69                             | 0.25                         | 0.11                        | 1.04                      | 0.78                        |
| November   | 6     | 108,609                 | 0.64                             | 0.33                         | 0.10                        | 1.06                      | 0.76                        |
| December   | 7     | 58,386                  | 0.57                             | 0.34                         | 0.14                        | 1.05                      | 0.39                        |
| Cumulative | 16    | 1,046,375               | 0.70                             | 0.29                         | 0.13                        | 1.11                      | 0.90                        |

Table 6.--Annualized mean number of sea days and standard deviations (in parentheses), by vessel class, for the lobster fleet in the Northwestern Hawaiian Islands, 1988.

|              |              |            | Mean number of sea days by activity |              |           |             |           |           |                |           |    |  |
|--------------|--------------|------------|-------------------------------------|--------------|-----------|-------------|-----------|-----------|----------------|-----------|----|--|
| Vessel class | Vessel (No.) | Trip (No.) | Sea days                            | Fishing      | Traveling | Running     | Weather   | Breakdown | Rest/deck work | Missing   |    |  |
| Unadjusted   |              |            |                                     |              |           |             |           |           |                |           |    |  |
| 1*           | 1            | --         | --                                  | --           | --        | --          | --        | --        | --             | --        | -- |  |
| 2            | 4            | 14         | 194.0 (39.8)                        | 156.0 (34.4) | 4.5 (3.3) | 26.5 (7.2)  | 2.0 (2.4) | 2.0 (4.0) | 3.0 (4.2)      | 0.0 (0.0) |    |  |
| 3            | 3            | 9          | 128.7 (43.8)                        | 98.0 (31.8)  | 1.3 (1.5) | 22.3 (12.3) | 3.3 (3.1) | 0.7 (1.2) | 1.7 (2.1)      | 1.3 (2.3) |    |  |
| Total        | 8            | 27         | 178.0 (58.5)                        | 139.0 (46.0) | 2.8 (3.0) | 26.4 (9.6)  | 3.4 (3.3) | 1.3 (2.8) | 3.8 (4.8)      | 1.5 (3.0) |    |  |
| Adjusted     |              |            |                                     |              |           |             |           |           |                |           |    |  |
| 1*           | 1            | --         | --                                  | --           | --        | --          | --        | --        | --             | --        | -- |  |
| 2            | 4            | 15         | 206.3 (26.7)                        | 166.0 (24.9) | 4.5 (3.3) | 28.3 (5.8)  | 2.0 (2.4) | 2.0 (4.0) | 3.5 (5.2)      | 0.0 (0.0) |    |  |
| 3            | 3            | 11         | 157.0 (33.7)                        | 120.0 (21.4) | 1.7 (2.1) | 26.3 (9.1)  | 4.7 (4.2) | 0.7 (1.2) | 2.0 (2.6)      | 1.7 (2.9) |    |  |
| Total        | 8            | 30         | 194.8 (44.3)                        | 152.3 (34.6) | 2.9 (3.0) | 28.8 (7.3)  | 3.9 (3.7) | 1.3 (2.8) | 4.1 (5.2)      | 1.6 (3.1) |    |  |

\*Confidential because fewer than three vessels participated in Class I.

The Class II vessels averaged a greater number of total sea days than either the fleet as a whole or the Class III vessels. The average trip duration for the Class II vessels in 1988 was >10% longer than the 1987 average. This increase is directly reflected in an increase in the number of fishing days (40 in 1987 vs. 44 in 1988). The only other area of significant change is in traveling days (i.e., when the vessel moves between banks), which were almost negligible in 1988. This analysis substantiates the reported trend in fishermen taking fewer trips per year but extending the duration of each trip.

#### RECENT DEVELOPMENTS

The NWHI lobster fishery stabilized in some areas in 1988 (e.g., trap-hauls and vessel participation); however, significant changes were seen in several trends. Of particular significance was the increase in spiny lobster landings, which more than doubled from 1987. Equally important was the decline in ex-vessel price of frozen tails as well as a general slackening in demand as reported by seafood wholesalers. Vessels apparently developed ways to increase trip length and trap-hauls per fishing day. Despite increased catch and effort, several vessels decided to forgo lobster fishing in winter 1988-89 and joined the expanding tuna longline fleet.

In 1987, the fishery experienced significant declines in participation and effort (trap-hauls). Along with contraction in fishing effort was a change in fleet configuration. These trends, as reported in 1987 (Clarke et al. 1988), appeared to stabilize in 1988. The fleet now consists of predominately Class II and III vessels. Only one vessel entered the fishery in 1988 (Table 7). All of the other vessels active in 1988 had been active in previous years.



Table 7.--Entry and exist patterns of individual lobster fishing vessels in the Northwestern Hawaiian Islands, 1983-88. Vessels are coded for purposes of confidentiality.

| Vessel<br>code | Entry and exit by month |                         |              |              |              |                    |
|----------------|-------------------------|-------------------------|--------------|--------------|--------------|--------------------|
|                | 1983                    | 1984                    | 1985         | 1986         | 1987         | 1988               |
|                | JFMAMJJASOND            | JFMAMJJASOND            | JFMAMJJASOND | JFMAMJJASOND | JFMAMJJASOND | JFMAMJJASOND       |
| Class I        |                         |                         |              |              |              |                    |
| A              |                         | XXXXXXXXXX <sup>a</sup> | XXXXXXXXXXXX |              |              |                    |
| B              |                         |                         | XXXXXXXXXXXX | XXXXXXXXXXXX |              |                    |
| C              |                         | XXXXXXXXXXXX            | XXXXXXXXXXXX | XXXXXXXXXXXX |              |                    |
| D              |                         |                         | XXXXXXXXXXXX | XXXXXXXXXXXX |              |                    |
| E              |                         |                         | XXXXX        |              |              |                    |
| F              |                         |                         |              | XXXXXXXXXX   |              |                    |
| G              |                         |                         |              | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX       |
| H              |                         |                         |              | XXXXXXXXXXXX | X            |                    |
| I              |                         |                         |              |              | XXXXX        |                    |
| J              |                         |                         |              |              |              | XX                 |
| Class II       |                         |                         |              |              |              |                    |
| K              | XXXXXXXXXXXX            | XXXXXXXXXXXX            | XXXXXXXXXXXX |              |              |                    |
| L              | XXXXXXXXXXXX            | XXXXXXXXXXXX            | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXX         |
| M              |                         | XXX                     | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX       |
| N              |                         |                         |              |              | XXXXXXX      | XXXXXXXXXXXX       |
| V              |                         |                         |              |              |              | XXXXXXXXXXXX       |
| Class III      |                         |                         |              |              |              |                    |
| O              | XXXXXXXXXXXX            | XXXXXXXXXXXX            | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX       |
| P              |                         | XXXXXX                  | XXXXXXXXXXXX | XXXXXXXXXXXX | XXXXXXXXXXXX | XX XXXX            |
| Q              |                         | XXX                     | XXXXXXXXXXXX | XXXXXXXXXXXX |              |                    |
| R              |                         | XX                      | XXXXXXXXXXXX | XX           |              |                    |
| S              |                         |                         | XXXXXXXXXXXX | XXXXXXXXXXXX | X            |                    |
| T              |                         |                         | XXXXXXX      |              |              |                    |
| U              |                         |                         | XXXXXXX      | XXXXXXXXXXXX | XXXXXXX      |                    |
| V              |                         |                         |              | XXXXXX       | XXXXXXXXXXXX | ..... <sup>b</sup> |
| W              |                         |                         |              |              | XXXXXXX      | XXXXXXXXXXXX       |

<sup>a</sup>Crosses (X's) indicate vessel activity within a class.

<sup>b</sup>Elipses indicate vessels that changed class.

These vessels apparently are becoming more efficient in terms of fishing effort. Several vessels managed to extend trip duration by reducing searching time (between banks) and replenishing supplies while on the fishing grounds. Vessels with a limited hold capacity contracted other vessels to bring bait, fuel, and provisions to the fishing grounds. The delivery vessels were normally NWHI bottom fish vessels that had excess capacity to deliver the needed commodities. Although occurring in only a few cases, this strategy, along with good weather, is believed to be responsible for the extended duration of the fishing trips in 1988.

The decision to increase trip duration apparently was the direct result of unexpectedly good fishing in 1988. Vessel owners and operators appeared to concentrate effort in order to capitalize on the high catch rates of spiny lobster. Recent fishery events and predictions (Polovina et al. 1988) indicated declining combined catch rates in 1988, but both environmental and fishery related factors appear to have combined to counteract those trends. Relatively good weather in winter and spring allowed fishermen to fish on top of the banks. In addition, fishermen reported that spiny lobster perhaps were more active when water temperatures were higher and seas were calm.

Slipper lobster landings dropped in 1988 to their second lowest level on record, mainly for two reasons: good spiny lobster fishing and declining ex-vessel prices. Slipper lobster were targeted on only three to four trips at the beginning of the year. Coincident with decreased slipper lobster fishing in early 1988, fishermen and seafood wholesalers reported poor demand, especially outside of Hawaii, and prices began to drop. At this time, fishermen were reporting good success targeting higher valued spiny lobster, so effort normally directed at slipper lobster (especially in the spring) went to spiny lobster. Fishing for spiny lobster was so successful at certain times of the year that several vessels reported "high-grading." High-grading is when a lower valued product (e.g., slipper lobster) is returned to the water in order to make room for a higher valued product (e.g., spiny lobster). Slipper lobster demand apparently strengthened, because the price drop stabilized. However, the ex-vessel price of spiny lobster tails continued to slide through the end of 1988.

Although spiny lobster fishing was good in 1988, prices dropped substantially. Prices of frozen NWHI lobster peaked at the end of 1987 but dropped throughout 1988. Year-end (1988) prices of spiny lobster frozen tails were between \$9 and \$10. Wholesalers reported a substantial worldwide supply, with bumper landings reported in Australia. Fishermen reported having again to absorb costs associated with packaging and storing, cutting into their margins.

The number of ridgeback slipper lobster reportedly caught in 1988 equaled 7,229 or about 4% of the numerical legal slipper lobster landings. This is down from the 13,524 reported caught in 1987 (Clarke et al. 1988). However, live ridgeback slipper lobster appeared to be gaining acceptance and sold for around \$7.50/lb. The 1988 reported catch could potentially yield 21,470 lb (9.8 t) of live product valued at  $\geq$ \$160,000. But only a total of 10,600 lb (4.8 t) of live lobster were reportedly landed in 1988,

so a significant part of the reported catch evidently went to frozen lobster tail production.

Octopus landings in 1988 were relatively insignificant compared with those observed in the recent past. Fishermen reported decreased catches of octopus due to escape vented traps. Apparently, the vent holes were large enough to allow the octopus to leave the trap when the gear was retrieved.

Despite good spiny lobster fishing in 1988, the downturn in prices, along with the hardships associated with winter lobster fishing, caused four lobster vessels to convert to tuna longlining. Three vessels adopted the monofilament system, and one, the basket system. All vessels reported that they planned to return, at least part-time, to lobster fishing in the spring of 1989.

Escape vents and slipper lobster minimum size regulations that went into effect in 1988 were generally given positive reviews by the active fishermen. High gear loss due to weakening of the traps by the addition of escape panels was feared initially but proved less than expected. A technician with the NMFS aided most of the fishermen in implementing the proper method of attachment of the panels, and gear loss as a result of the panels was minimal.

#### ECONOMIC ANALYSIS

A recently completed cost-earnings study (Clarke and Pooley 1988) on the economic performance of the NWHI lobster fishing vessels during 1985-86 was updated in the last annual report. Economic information on a prototypical lobster fishing vessel was calculated as if the cost structure remained essentially the same as in 1985-86. Unit prices, such as the cost of bait and fuel, were adjusted to 1987 levels. Cost-earnings in 1987 were estimated for a mid-sized vessel (a composite of Class II-III vessels).

The same procedure was employed in this report because the fleet was composed predominately of Class II-III vessels in 1988. Cost-earnings of a prototypical vessel, which is a composite of the Class II and III vessels, were estimated by using operational data from the actual vessels' performance during 1988, annualizing, and then adjusting costs for inflation (Table 8).

Net revenue (profit) for the prototypical vessel increased from an estimated \$124,000 in 1987 (Clarke et al. 1988) to \$196,000 in 1988, and labor income rose from \$157,000 in 1987 to \$210,000 in 1988. The main reason for the substantial increases in net revenue and labor income was the jump in gross revenue. Despite a 20% decline in average product price, total revenue increased 34%, due mainly to a 58% increase in production per fishing day. Cost structure was essentially the same, except for substantial increases in gear and handling costs. Gear costs were adjusted upward to reflect the costs of implementing the escape vent regulation, whereas handling costs were increased because of reported increases in packaging and cold storage charges associated with reduced lobster demand.



Table 8.--Prototypical income statement and operating characteristics for a mid-sized lobster vessel operating in the Northwestern Hawaiian Islands, 1988 (composite of Class II and Class III vessels).

| Income statement                 | US\$ <sup>a</sup> |
|----------------------------------|-------------------|
| Revenue                          | 663,406           |
| Fixed costs                      | 131,737           |
| Capital cost and recovery        | 46,520            |
| Repairs                          | 19,698            |
| Vessel insurance                 | 30,371            |
| Administrative                   | 11,188            |
| Other                            | 23,959            |
| Operating costs                  | 335,281           |
| Fuel and oil                     | 29,487            |
| Bait                             | 30,781            |
| Handling                         | 22,944            |
| Provisions                       | 13,471            |
| Medical                          | 390               |
| Supplies                         | 4,036             |
| Gear                             | 17,613            |
| Other                            | 6,773             |
| Crew share                       | 193,648           |
| Captain's share                  | 16,137            |
| Total cost                       | 476,017           |
| Net revenue                      | 196,389           |
| Operating Characteristics        |                   |
| Investment (\$)                  | 414,990           |
| Trips (No.)                      | 3.8               |
| Catch per trip (lb)              | 449               |
| Trip days (No.)                  | 185               |
| Fishing days (No.)               | 146               |
| Crew share (%)                   | 36                |
| Crew (No.)                       | 6                 |
| Product price (\$/lb)            | 10.12             |
| Total catch (lb)                 | 65,554            |
| Depreciation factor <sup>b</sup> | 0.07              |
| Capital factor <sup>c</sup>      | 0.08              |

<sup>a</sup>Totals may not sum due to rounding.

<sup>b</sup>A refurbishment life of 15 years.

<sup>c</sup>Prime interest rate.

The cost-earnings information given in Table 8 represents a composite of the Class II-III vessels operating in the NWHI lobster fishery in 1988. Income for the entire NWHI fleet has been estimated (Table 9) from the weighted income for all vessel classes. Data for previous years have been revised slightly from last year's annual report because of adjustments in reported total revenue.

Compared with previous years (1986 and 1987), it appears that 1988 was a particularly good year for NWHI lobster fishermen. Net revenue amounted to 24% of the total revenue in 1988 compared with 10% in 1987, and the fleet generated substantial labor income. Although the increase in returns from the fishery was obviously a result of the good fishing seen in 1988, the fleet as a whole appeared also to be more efficient in terms of configuration. Class II vessels, on average, were estimated to be the most efficient of the three vessel classes (Clarke and Pooley 1988). In 1988, Class II vessels were predominant in the fleet. One vessel moved up from Class III in 1987 to Class II in 1988 because of its increased fishing power and production. This reconfiguration and the reduced number of Class I vessels have apparently resulted in a more efficient fleet.

These results suggest that the NWHI lobster fishing industry, as a whole, yielded a significant return on investment in 1988 in contrast to recent years in which economic data suggested the fishery was performing at the open access level of economic performance (i.e., the fleet as a whole generated minimal profits). In 1989, if present catch rates are maintained and ex-vessel prices stabilize, effort will most likely increase. This increase will probably be in trap-hauls but may also be manifested in additional vessels joining the fishery.

Table 9.--Income estimations for the lobster fleet operating in the North-western Hawaiian Islands, 1986-88.<sup>a</sup>

|                     | Income (in millions US\$) |      |      |
|---------------------|---------------------------|------|------|
|                     | 1986                      | 1987 | 1988 |
| Fleet income        |                           |      |      |
| Gross revenue       | 6.0                       | 4.0  | 5.0  |
| Net revenue         | -0.2                      | 0.4  | 1.2  |
| Labor income        | 1.7                       | 1.1  | 1.4  |
| Total income        | 1.5                       | 1.5  | 2.6  |
| Fleet configuration |                           |      |      |
| Class I             | 5                         | 2    | 1    |
| Class II            | 3                         | 3    | 4    |
| Class III           | 7                         | 4    | 3    |

<sup>a</sup>Figures in this table are estimated from annualized estimates of earnings per vessel.

## RESEARCH

### Biological Assessment

In 1988, the Honolulu Laboratory conducted the fourth annual lobster assessment survey to determine the status of the lobster stocks in the NWHI. Research data from that and previous surveys, along with commercial logbook data, were used in the assessment, which is documented in Polovina and Moffitt (1989). Major highlights of this survey include the following:

- (1) Research sampling indicates that, at both Maro Reef and Necker Island, the CPUE's for spiny lobster below the minimum size have increased slightly since 1977, whereas the CPUE's for those above the minimum legal size have declined dramatically.
- (2) At Maro Reef and Necker Island, the average tail width at the onset of egg production in females has declined for both spiny and slipper lobsters.
- (3) Spiny lobster attain their minimum legal size of 5.0 cm tail width at 3.1 years after larval settlement, and slipper lobster reach minimum legal size (>5.6 cm tail width) at 3.3 years after larval settlement.
- (4) If effort is unchanged in 1989, the biological model predicts combined spiny and slipper lobster landings will decline 8%.
- (5) The revised estimate of maximum sustainable yield for the fishery is 1.14 million legal lobster (spiny and slipper lobsters combined) at a corresponding fishing effort of 848,000 trap-hauls.
- (6) The unpredictably high spiny lobster catch rates are attributed to a variety of possible factors, including increases in exploitable population size and use of escape vented traps in 1988.

### Economic Research

A cooperative research project on the economics of commercial lobster fishing in the NWHI, initiated in 1986, was completed with the project's fifth report, "An Economic Appraisal of Effort Management Alternatives for the Northwestern Hawaiian Islands Commercial Lobster Fishery" (Samples and Sproul 1988). Previous reports focused on (1) the dynamics and fishing patterns in the NWHI lobster fishery (Gates and Samples 1986), (2) a survey of wholesale lobster dealers and brokers in the mainland United States (Samples and Gates 1987), (3) cost-earnings of the commercial fishing sector (Clarke and Pooley 1988), and (4) the potential economic effects of limited entry management (Samples and Sproul 1988). The first two reports were completed in 1986 and have been summarized in Clarke et al. (1987). The second two, completed in 1987, are summarized in Clarke et al. (1988).



The fifth report reviews five management measures: licensing, trip limits, trap limits, and season and area closures. Each is explored in terms of operational considerations, effort reduction potential, effects on industry profits, and creation of economic hardship. The report concludes the following:

- (1) All five measures are enforceable and consistent with the Magnuson Fishery Conservation and Management Act of 1976, depending on the specific ways in which they are implemented.
- (2) All five regulatory measures generate effort reduction.
- (3) The process of dynamic adjustment is complex and involves three phases:
  - (a) Fishermen are predicted to respond to the new regulation by initially dropping their trapping intensity.
  - (b) Fishermen make appropriate adjustments in their productive inputs (e.g., sea days, traps, gear) to maximize profits.
  - (c) The biological effects of the regulation manifest in the form of higher CPUE and motivate effort expansion.
- (4) The effects on industry profits are potentially positive for licensing; however, for all others, the potential for increased profits is dissipated by new entrants.
- (5) All measures, with the possible exception of a licensing system, in some way create an economic hardship.

### Management

A report documenting how the NMFS Honolulu Laboratory determines CPUE was released in 1988 (Clarke and Todoki 1988). It explores several different methods for calculating CPUE, investigates the effects of multiple trap-nights on fishing success, and presents several conclusions:

- (1) The effects of multiple trap-nights are complicated by the interaction of biological, oceanographic, and fishery factors.
- (2) Length of soak time (greater than one night) appears not to be justified in terms of proportionately greater catch.
- (3) Catch per trap-haul is recommended as the best measure of CPUE from both a biological and operational standpoint. This measure has been used in all NMFS reports this year.

## Other

The Western Pacific Regional Fishery Management Council (Council) had recommended research efforts designed to establish a number of scenarios whereby new regulations might be required for the fishery. This "framework plan" process was later dropped when the Plan Monitoring Team concluded that the information for constructing reasonable scenarios was unavailable.

## ENDANGERED AND THREATENED SPECIES INTERACTIONS

The Daily Lobster Catch Report per Statistical Area requires reporting monk seal, Monachus schauinslandi, and sea turtle sightings or interactions in the NWHI lobster fishery (Table 10). In 1988, fishermen hauled gear on a total of 1,154 days and reported sightings of or interactions with monk seals on 46 different occasions, up slightly from the 44 reported in 1987. As in 1987, Necker Island was the area at which most monk seal sightings were made in 1988. Turtle sightings were reported on only two different occasions in 1988. Fishermen may sight greater numbers of monk seals and turtles but not take time to report them during what are usually quite hectic daily fishing operations. Therefore, these numbers of sightings and interactions are not considered to be an accurate quantitative indicator of abundance. No reports of physical interactions with monk seals or turtles were filed in 1988.

Table 10.--Reported sightings of or interactions with endangered or threatened species by the lobster fleet in the Northwestern Hawaiian Islands, 1988. Statistical areas are defined in the Daily Catch Report per Statistical Area form.

| Area                                            | No. of sightings by No. of individuals |                 |                   |
|-------------------------------------------------|----------------------------------------|-----------------|-------------------|
|                                                 | One individual                         | Two individuals | Three individuals |
| Monk seals observed in statistical area         |                                        |                 |                   |
| Maro Reef                                       | 1                                      |                 |                   |
| Necker Island                                   | 25                                     | 1               |                   |
| St. Rogatien Bank                               | 8                                      |                 |                   |
| Gardner Pinnacles                               | 2                                      |                 | 2                 |
| Monk seals observed in vicinity of fishing gear |                                        |                 |                   |
| Necker Island                                   | 5                                      | 2               |                   |
| Turtles observed in statistical area            |                                        |                 |                   |
| Necker Island                                   | 2                                      |                 |                   |

## COUNCIL ACTIVITIES

## Plan Monitoring Team and Advisory Panel Action

Both the Council's Crustacean Plan Monitoring Team and Advisory Subpanel met in 1988, but a report of their activities was unavailable.

## ADMINISTRATIVE ACTIVITIES

The year 1988 marked the sixth year of enforcement of regulations since the Crustacean FMP was implemented in March 1983. With the approval of Amendment 5 to the FMP in late 1987, several important changes to the lobster management program were implemented. Slipper lobster were, for the first time, subject to a size limit restriction and a prohibition on the taking of egg bearing female lobster. In addition, all lobster traps used in the NWHI were required to have escape vent panels to allow escapement of undersized spiny and slipper lobsters. Finally, Amendment 5 revised a number of reporting requirements to better reflect the evolving nature of the fishery.

## Permits

A total of 26 vessels were issued permits for the lobster fishery in calendar year 1988. The total trap carrying capacity for permitted vessels in 1988 was 19,885. Of the 26 vessels permitted, 4 were issued permits for area 2, the EEZ around the main Hawaiian Islands. All others were permitted for the NWHI, permit area 1. No permits were issued for permit area 3, the EEZ around American Samoa and Guam.

In 1988, only 9 of the 26 vessels issued permits actually participated in the fishery. This is slightly less than the 11 vessels that participated in 1987. The 9 active vessels in 1988 had a registered carrying capacity totaling 9,420 traps, slightly more than in 1987 (Table 11).

Table 11.--Permit and vessel activities of the spiny lobster and slipper lobster fishery in the Northwestern Hawaiian Islands, 1983-88.

| Year | Permits issued | Active vessels | Trap carrying capacity of active vessels | Average trap carrying capacity of active vessels |
|------|----------------|----------------|------------------------------------------|--------------------------------------------------|
| 1983 | 14             | 4              | 1,200                                    | 300                                              |
| 1984 | 19             | 11             | 5,240                                    | 476                                              |
| 1985 | 45             | 16             | 12,250                                   | 703                                              |
| 1986 | 54             | 16             | 13,580                                   | 849                                              |
| 1987 | 41             | 11             | 9,150                                    | 832                                              |
| 1988 | 26             | 9              | 9,420                                    | 1,047                                            |



## ENFORCEMENT ACTIVITIES AND VIOLATIONS

The NMFS enforcement agents inspected 19 off-loadings of lobster in Honolulu in 1988. Agents are unaware of any off-loadings other than in Honolulu. Only 1 violation was detected (a vessel using traps without escape panels), compared with 3 violations in 1987, 9 in 1986, and 22 in 1985. This certainly illustrates the commercial lobster fishermen understand the regulations and are complying with them.

The decrease in lobster enforcement activities is due partly to the exodus of several vessels from the lobster fishery to other fisheries. We are unable to determine whether this trend will continue.

### Enforcement Problems

The integrity of the lobster traps once the escape vent panels have been added seems to have been a problem in 1988. These vents and a major structural post are located in the same area. By removing this structure, the escape vents tend to collapse on themselves, reducing the size of the escape vent. Also, once the support post between the actual circular vents has been broken, there seems to be no way to repair it without reducing vent size.

The Crustacean FMP should be changed to reflect the management authority over all U.S. possessions, not just permit areas 1, 2, and 3.

Training, a personnel vacancy, and temporary duty assignments of Southwest Region Enforcement agents in 1988 reduced enforcement capabilities in the Honolulu Office considerably. The Honolulu Office is not operating at full complement at this time.

## RECOMMENDATIONS

### Southwest Fisheries Center Recommendations

The Southwest Fisheries Center has no recommendations on the western Pacific lobster fishery managed under the Crustacean FMP.

## SUMMARY

1. All of the fishing regulated by the Crustacean FMP took place in the NWHI, permit area 1 in 1988.
2. In 1988, 553 t (wet weight) of spiny lobster valued at \$4.4 million were landed, while 85 t of slipper lobster, Scyllarides spp., valued at \$0.6 million were landed. Total ex-vessel revenue 1988 was \$5.0 million, up 25% from 1987.

3. Logbooks of fishermen indicate that 889,005 legal spiny lobster and 168,607 legal slipper lobster were caught in 1988. Legal spiny lobster landings rose significantly (up 125% over 1987) while total slipper lobster landings dropped 42% from 1987.
4. Slipper lobster minimum size and reporting regulations were enacted for the first time in 1988. Of the 278,780 slipper lobster caught, 60% were legal, 25% sublegal, and 15% berried.
5. The three most important fishing grounds (in descending order) in terms of numbers of spiny and slipper lobsters caught were Maro Reef, Necker Island, and Gardner Pinnacles.
6. In 1988, a total of 9 federally permitted vessels took 28 trips and fished 845,182 trap-hauls in the NWHI.
7. The CPUE for legal spiny lobster reversed a 5-year trend (of decline) and rose substantially in 1988. Legal spiny lobster CPUE rose from 0.49 in 1987 to 1.05 in 1988. However, total slipper lobster CPUE continued to decline from 0.59 in 1987 to 0.33 in 1988. The combined CPUE for legal spiny lobster and total slipper lobster rose 28% from 1987 levels.
8. The ex-vessel price of frozen lobster tails dropped from record 1987 levels. In 1988, spiny lobster tails averaged \$10.19/lb and slipper lobster tails averaged \$9.03/lb. However, live lobster prices continued to rise to around \$7.50/lb.
9. Seasonal data presented by date of haul indicate that spiny lobster CPUE peaks around August while slipper lobster CPUE peaks in April of each year.
10. Biological assessment studies indicate the condition of the lobster stocks appears good, present regulations adequately protect spawning biomass, and 1988 catch and effort levels are within confidence levels estimated for maximum sustainable yield.
11. Economic analysis indicates that, despite a substantial drop in ex-vessel lobster prices, vessels on average yielded positive returns on investments.
12. The Council decided to defer plans to create a "framework plan" for crustaceans.
13. Enforcement agents reported good compliance with NWHI lobster regulations by fishermen.

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